

ABSTRACT

Ion optical methods and apparatus are provided for producing low energy ion beams. The apparatus includes an acceleration electrode for accelerating the ion beam, a deceleration
5 electrode downstream of the acceleration electrode for decelerating the ion beam, and an ion
optical element downstream of the deceleration electrode for inhibiting electrons in the beam
plasma from reaching the deceleration electrode. The deceleration electrode is biased at a
voltage that is selected to provide a potential barrier to thermal ions in the beam plasma to
inhibit the thermal ions from reaching the acceleration electrode. The ion optical element
10 maybe implemented as an electron repulsing electrode or as a magnetic element. The
acceleration electrode, the deceleration electrode, or both, may be segmented in a direction
lateral to the ion beam to define individually controllable electrode segments. The ion optical
apparatus may be implemented as an ion source extraction system or as a deceleration lens
system.

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